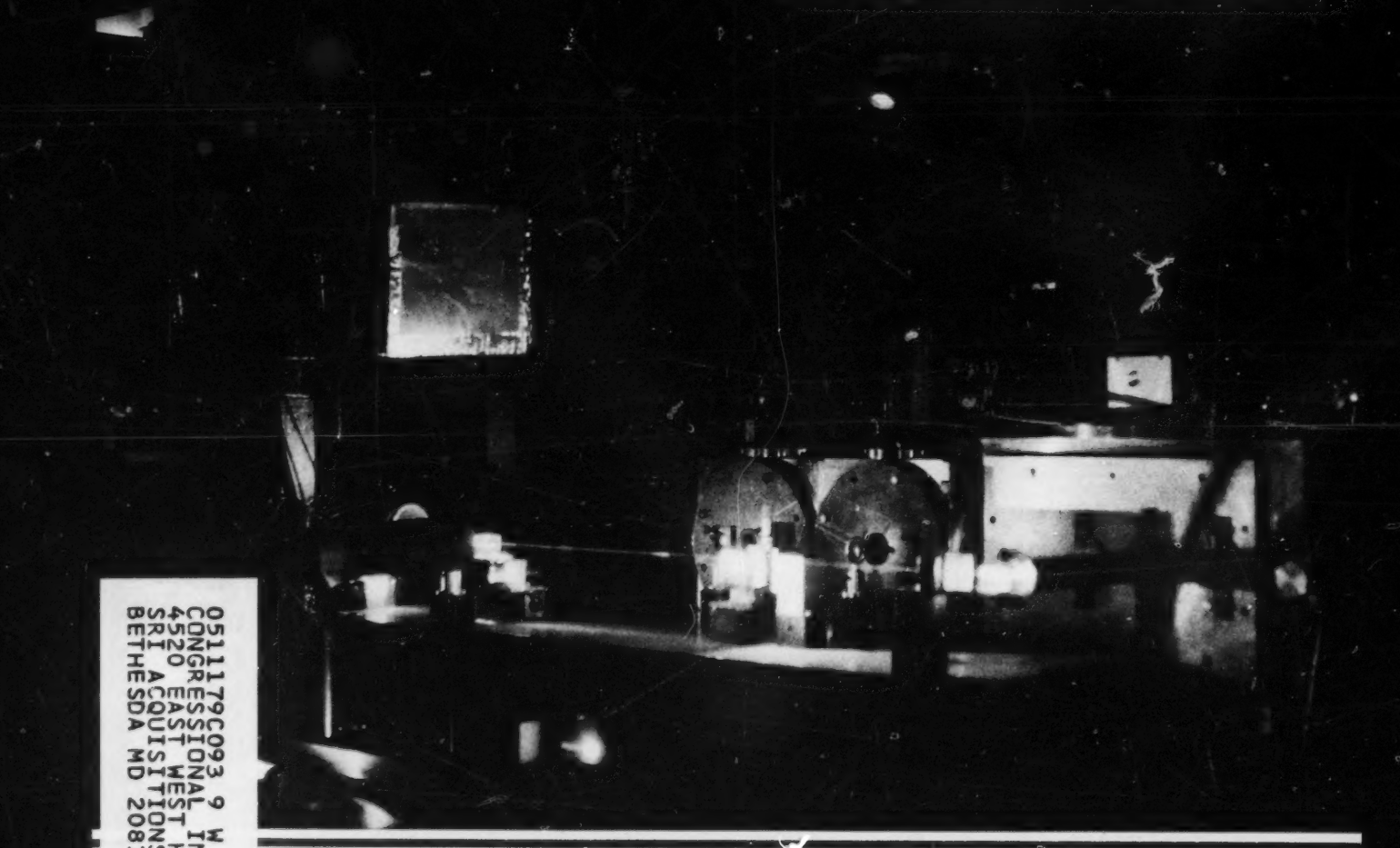
AUGUST 22, 1983

CHEMICAL & ENGINEERING

NEWS

Fiber intermediates struggle to recover
A Key Chemicals Review Page 10

A1250-1 8/22/83



05111179C093 9 W AR6134SL 1
CONGRESSIONAL INFO SERV
4520 EAST WEST HWY SUITE 800
SRI ACQUISITIONS
BETHESDA MD 20814

METAL CLUSTERS

Pulsed-beam source offers new insights

Page 22

Cover: In supersonic molecular beam apparatus laser beam is deflected to where it vaporizes a nickel rod to produce the clusters to be studied. Photo courtesy of Richard E. Smalley, Rice University

Volume 61, Number 34
CENEAR 61 (34) 1–48
ISSN 0009-2347

CHEMICAL & ENGINEERING
NEWS
AUGUST 22, 1983

News of the Week

■ **Rise in bromine levels in Arctic air in spring measured; element may be linked to destruction of the stratospheric ozone layer.** **Page 6**

■ **House subcommittee cites Defense Department for laxity in hazardous waste disposal.** **Page 7**

■ **Coal scientist points up danger of drop in synfuels R&D funding brought on by current oil glut.** **Page 7**

■ **Laser-based analysis system may shorten time needed to determine molten steel composition.** **Page 7**

Business

Fiber intermediates are not enjoying the general U.S. economic recovery; though synthetic fibers business improves, DMT/PTA, ethylene oxide, and cyclohexane gain little. **Page 10**

Government

Assessment of operations of the Defense Science Board leads to charges of failure to comply with law and policy directives and possible conflict of interest on part of members. **Page 15**

Administration policy on acid rain control is expected to come out of EPA report to be refined by cabinet council. **Page 16**

Education

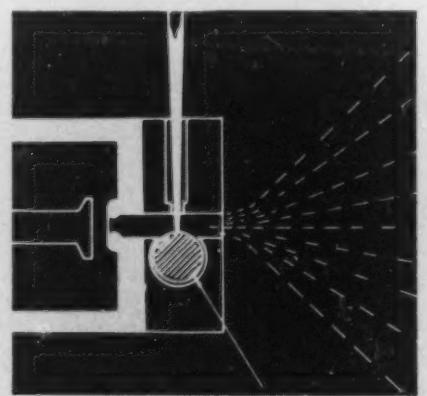
Chemistry departments at several state universities have survived the economic crunch; California, Michigan schools cite healthy research support, academic strength. **Page 34**

The number of scientists and engineers employed at colleges and universities continues to grow, NSF reports. **Page 36**

Letters 5

Concentrates
Business 8
Government 14
Science/Technology 20

The Departments
New Products 33
People 46
Newscripts 48



Science

Laser pulse that generates molecular beams of metal clusters simplifies spectra interpretation. **Page 22**

Fiber Intermediates Plod Through Slow Recovery

Despite much improved year in fibers demand, major intermediates—DMT/PTA, ethylene oxide, cyclohexane—still are struggling

Bruce F. Greek, C&EN Houston
William F. Fallwell, C&EN Washington

The remarkably strong general economic recovery in the U.S. this year still has left a few major chemical groups behind. The major intermediates going into synthetic fibers are one of these lagging groups. This may sound odd considering the greatly improved fibers business (C&EN, May 30, page 11), but for several basic reasons, it's true.

The three big-volume fiber intermediates whose immediate market prospects appear in the following pages—dimethyl terephthalate/purified terephthalic acid (DMT/PTA), ethylene oxide, and cyclohexane—trail the overall recovery pace for basic chemicals and won't make their producers very happy this year. In this respect, they don't correspond at all with the brightened outlook for the plastics intermediates, whose performance has jumped very much in tune with downstream polymers (C&EN, June 20, page 16).

Why don't the fiber intermediates also follow suit with their chief polymer uses? First, supply and demand in fiber intermediates is way out of line with the corresponding situation in fibers. The main reason is that the intermediates didn't go through nearly so wrenching a shakeout in plants and producers as did fibers after the mid-1970s. In fact, there were some capacity expansions. Intermediates producers are still stuck with yawning excess capacity. Several plants are shut down, but could in theory be restarted.

Key Chemicals

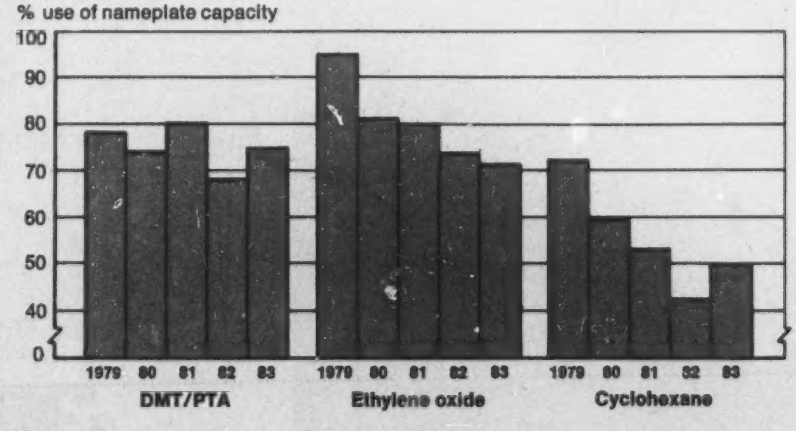
Second, the foreign trade turnaround hurting chemicals in general has been extra hard on fiber intermediates. Although DMT/PTA haven't yet been nicked by imports, their exports are down more than two thirds since the late 1970s. For ethylene oxide, it's foreign trade in derivative ethylene glycol that is beginning to suffer. Glycol exports are expected to drop considerably in coming years after taking about 12% of production in 1982. Meanwhile, large glycol imports are feared for a net trade deficit. In cyclohexane, foreign trade was even more important in the late 1970s, taking about 18% of U.S. production. This year, more than three fourths of this export volume is gone, and what remains will take only about 5% of production.

Add it up, and the intermediates are well behind the recovery pace in fibers. For the three covered here, 1983 production will total about 12.6 billion lb, up 9% from 1982 but still down 5% from the 1979 record. Dollarwise, things are much worse. Total value of about $4.15 billion for the three intermediates this year is down fully 18% from the 1981 peak of $5.1 billion, even after an 11% pickup from 1982.

Plant capacity use remains low this year for all three chemicals, even dropping a bit for ethylene oxide. So there will be no major new capacity for quite a while. Severely depressed profit margins are beginning to move up, but producers are happy just to play catch-up in this business cycle. New investment will have to wait.

In short, fiber intermediates didn't pay the price that fibers did over the past decade. For this and other reasons, intermediates are not in a position to profit very much from even a strong general recovery.

Plant use will stay low this year despite market pickup

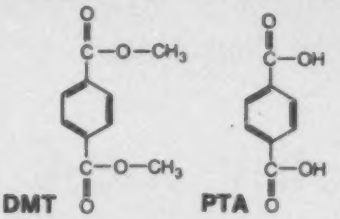


Sources: Industry and C&EN estimates, International Trade Commission

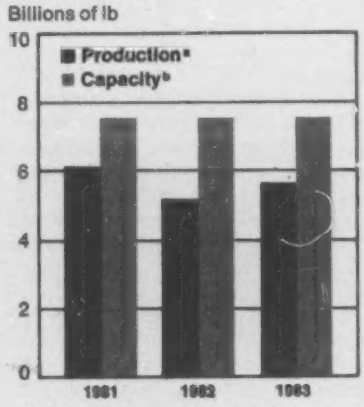
Key Chemicals

DMT/PTA

- ***Demand recovering***
- ***Capacity holding***
- ***Prices firmer***



PRODUCTION/CAPACITY



a DMT plus DMT equivalents of PTA (1.0 lb of PTA = 1.17 lb of DMT). b First quarter.

HOW MADE

Oxidation of p-xylene and concurrent esterification with methanol to make DMT; oxidation of p-xylene to make PTA

MAJOR DERIVATIVES (U.S.)

Polyethylene terephthalate 90%, polybutylene terephthalate 5%

MAJOR END USES (U.S.)

Polyester fibers 70%, films 10%

FOREIGN TRADE

Exports—declining to below 100 million lb in 1983, imports—negligible

PRICES

List prices about 35 cents per lb for DMT, 39 cents for PTA

COMMERCIAL VALUE

$2 billion for production, 1983

U.S. producers of dimethyl terephthalate (DMT) and purified terephthalic acid (PTA) are shaking off the effects of a very bad year in 1982. Their recovery is moving along but has quite a way to go. It will take well into 1984 for them to get back to record 1981 production levels, provided the general economic recovery doesn't stall out.

The improvement in demand this year for DMT and PTA has been under way since the second quarter, apparently gathering strength. This pickup, however, wasn't strong enough to give DMT/PTA a year-to-year gain in the first half. Even so, there has been a definite pickup compared to fourth-quarter 1982 and first-quarter 1983.

Assuming the demand improvement continues, upcoming monthly comparisons with 1982 could be spectacular. Although the recovery may slow toward the end of the year, it still may be enough for at least a 10% overall production gain in 1983 to 5.7 billion lb (with PTA converted to DMT equivalents at a 1:1.17 ratio). This would be up from 5.2 billion lb on the same basis in 1982.

Plant capacity for DMT and PTA totals a steady 7.6 billion lb per year. If 1983 production reaches 5.7 billion lb, the average plant operating rate will be 75% of the nameplate total. The last time the operating rate reached 80%—considered the threshold for good profitability in most chemicals—was in 1981. The 1983 operating rate then will not make the year anything special financially. It also will not precipitate any rush for capacity expansion. Such expansion is actually a few years off, since long-term growth in downstream polyesters was slowed drastically by the recent recession.

If the economic recovery continues in 1984, perhaps at a slower pace, production of DMT/PTA will continue to rise at a rate above the long-term forecast. It might be up 7 to 8% over 1983 to outstrip the peak 6.1 billion lb of 1981.

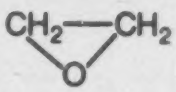
At the same time, the market pattern is changing. Exports of DMT/PTA have declined in recent years, partly because of the worldwide recession but also trade restrictions. Unless the recent textile trade pact with China (C&EN, Aug. 8, page 4) spurs demand for exports of DMT/PTA derivatives, largely polyester staple, U.S. markets will have to absorb declining DMT/PTA exports.

The U.S. market mix also is changing as fast-growing bottle resins made from DMT/PTA take an ever larger slice. In 1983, polyester bottle resins are not expected to increase this share very much because polyester fiber demand also is doing well. However, future potential growth for polyester resins in bottles remains large, especially if technical problems such as poor shelf life and hot-fill capability are solved. Although these problems could take some time to overcome, others such as competitive cost-performance for half-liter soft-drink bottles could be handled much faster, perhaps as early as this year. This development and other small new uses could push the bottle outlet for DMT/PTA above 10% of the total in 1984.

Hence, bottle resins could be the boost that DMT/PTA need to regain plant use and profitability levels to spark new investment. Bottle resin producers and consultants are extremely optimistic about market growth this decade, citing the small soft-drink bottle as the immediate target. Longer term, it's the untapped beer-bottle market that has resin makers most excited. To crack this area will require improvements in resins, but producers think they may have the grades they need by the late 1980s.

Well-established polyester fiber demand accounts for almost 70% of U.S. use of DMT/PTA. After slipping in the severe recession of 1982, this use is back up again but probably will go into a long, slow decline in its share of the total production, since fiber volume will not rise nearly so fast as will bottles or film. Specifically, longer-term growth rates for fibers are forecast to be about 3% a year, compared to 6 to 12% for film and bottles. Of course, as with all fibers, forecasts are subject to drastic changes because of fashion changes in the apparel market.

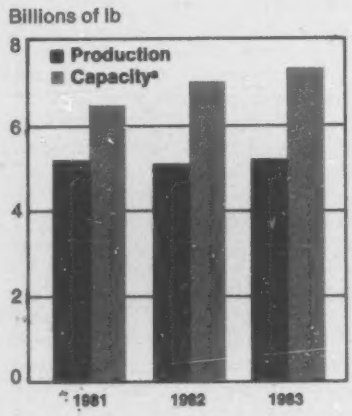
On balance, 1983 is a year rewarding the hard-pressed staying power of DMT/PTA producers. If the recovery continues in 1984, producers will get further dividends for not rushing capacity expansion plans in the early 1980s. Even so, DMT/PTA will not be one of the better basic chemical businesses this year.



Ethylene Oxide

- ***Demand up slightly***
- ***Supply growing***
- ***Prices still weak***

PRODUCTION/CAPACITY



a First quarter.

HOW MADE

Vapor-phase oxidation of ethylene with oxygen or air

MAJOR DERIVATIVES (U.S.)

Ethylene glycol 60%, ethoxylates 10%, glycol ethers 10%

MAJOR END USES (U.S.)

Polyester fibers, films, and resins 30%; antifreeze 25%; surfactants 10%; solvents 5%

FOREIGN TRADE

Exports—probably below 10 million lb in 1983, imports—below 50 million lb

PRICES

List price 45 cents per lb

COMMERCIAL VALUE

$1.75 billion for production, 1983

Ethylene oxide's strange holding pattern is heading through its sixth year in 1983. Once again, production is fluctuating a bit over 5 billion lb, and producers have the same old fight with profitability. In other words, for this product a good year in the economy isn't much different from a bad year.

Production in 1983 is climbing perhaps 2% from 1982 to about 5.2 billion lb, partly because of capacity additions that force more product inventory. It will take a lot longer before production again reaches the record 5.7 billion lb of 1979. An eventual new record is widely forecast but is clouded by a loss of derivatives exports, mainly in ethylene glycol, and a companion rise looming in derivatives imports.

Oddly, plant capacity in ethylene oxide continues to rise. In 1983, the latest round of expansions will be completed with a unique plant transported from Puerto Rico to Beaumont, Tex. This unit, a joint venture of PPG Industries and Du Pont, has been missing from C&EN's capacity totals since the turmoil in Puerto Rican chemicals in the late 1970s.

Further new capacity isn't even in the discussion stage because of the likelihood of net imports of ethylene oxide derivatives later in the 1980s. Older, currently shut-down capacity also is considered unlikely to restart. Overall, nameplate capacity of 7.3 billion lb per year at the beginning of 1983 (not all of it operating) will increase 4% during the year. As usual, there also will be some small debottlenecking increases undetected in the official totals.

Since the new Texas plant will come on late in the year, existing capacity will run at an average of 70 to 75% of nameplate capacity to meet the production forecast for 1983. Unfortunately, this rate is even lower than in 1982, contrary to the rising trend in most big-volume chemicals.

Most ethylene oxide production continues to be consumed at the plant site, chiefly in ethylene glycol, which takes nearly two thirds of it. Other captive outlets are ethoxylates, ethers, and amines. Merchant U.S. sales of ethylene oxide run less than 10% of production. Foreign trade in ethylene oxide itself also is very small.

Derivatives sales are therefore the main engine in ethylene oxide trends. Ethylene glycol goes largely to polyesters for subsequent use in fiber, film, and bottles. Antifreeze is the next largest glycol outlet.

Glycol uses presented a diverse picture in early 1983. Polyester demand was relatively strong because of a significant improvement in the fibers market plus continuing strong growth in bottle resins. Now, however, according to some industry analysts, the big rise in overall demand for polyester is over, although demand continues to stay high for fibers. Bottle demand is expected now to rise more slowly, with seasonal variations in the soft-drink market. Longer term, as with DMT/PTA, bottles may give ethylene oxide a major pickup as markets open up in small soft-drink containers and, much later, in beer bottles.

Antifreeze, which makes up about a quarter of U.S. demand for ethylene oxide, is entering its critical time of year. Most antifreeze bottling has peaked, and movement into distribution channels is well under way. Antifreeze producers are hopeful that an inventory runup in 1982 due to the recession will not be repeated. This excess inventory finally was worked off in the first and second quarters of 1983. With their real-dollar income generally up, consumers have less incentive for squeezing another year from their cars' antifreeze, so antifreeze demand may be up modestly this fall. Even so, with more and more small cars and small radiators on the road, the outlook for growth in antifreeze demand for ethylene oxide remains low, perhaps 2% per year on average.

Exports of ethylene glycol have been large, about 500 million lb last year. This market could diminish soon as Canadian producers move in aggressively with product made from lower-cost feedstocks. A dent in exports would rob glycol of one of its best growth areas over the past half decade. Since 1978, glycol exports mushroomed more than threefold by 1982.

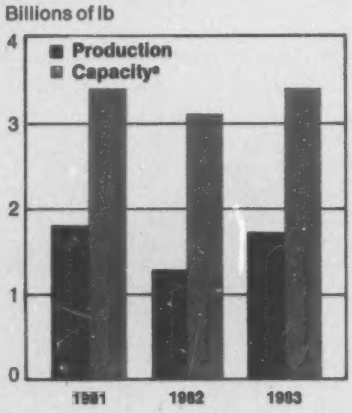
Demand will increase for other smaller uses of ethylene oxide in 1983 and 1984, but none are large enough to do much for total ethylene oxide demand. Hence, ethylene oxide will be riding as usual with ethylene glycol—not the happiest of prospects.

Key Chemicals

Cyclohexane

- ***Demand back up***
- ***Capacity up***
- ***Prices rising***

PRODUCTION/CAPACITY



a First quarter.

HOW MADE

Catalytic hydrogenation of benzene; recovery from natural gasoline

MAJOR DERIVATIVES (U.S.)

Adipic acid 60%, caprolactam 30%

MAJOR END USES (U.S.)

Nylon 66 60%, nylon 6 30%

FOREIGN TRADE

Exports—declining to possibly below 100 million lb in 1983, imports—negligible

PRICES

List price $1.64 per gal; discounting general

COMMERCIAL VALUE

$400 million for production, 1983

Cyclohexane is tied firmly to derivative nylon and has to ride with its ups and downs. In end-market terms, because nylon's biggest use is in carpets, cyclohexane really depends on the big-ticket consumer durables side of the economy, especially new housing.

That's not bad in 1983, since housing has enjoyed a big upswing. With some lag due to product pipeline filling, cyclohexane indeed has felt the surge downstream. Production is expected to be up nearly one third this year to 1.7 billion lb after tumbling nearly one half from its peak of 2.4 billion lb in 1979. Cyclohexane's performance in the previous three years was one of the worst in the whole chemical industry because of the general shellacking in nylon markets. However, cyclohexane's upturn this year and next could be one of the strongest, since nylon is in a robust recovery.

An important reason cyclohexane has such gyrations is that it no longer has a big swing market in exports. Once 18% of production, exports are now down to about 5%.

An important influence in cyclohexane's rebound is inventory building throughout its product chain. But one industry analyst says that inventory building in carpet nylon is about over, since suppliers have a clearer idea now of the year's carpet demand in new and resale houses. Beginning this quarter, carpet fiber production will follow more closely actual sales, and inventory building will become relatively minor, increasing only in line with carpet sales. This would mean that cyclohexane demand still will go up through the rest of 1983, but not at the former fast rate.

If growth does hold up through 1983, cyclohexane production would nearly make it back to the 1981 level. One subtle factor in the output rise, analysts suspect, is that the official government data may be slowly catching up with previously unreported production. This would mean that official production figures over the years for cyclohexane have been biased low. Such a variance partly explains the product's extraordinarily low apparent capacity use of recent years.

Plant capacity for cyclohexane also will continue shifting. In 1981, Commonwealth Oil's plant in Puerto Rico was shut down permanently, cutting about 300 million lb per year from total capacity. Then earlier this year, Du Pont added a bit more than 300 million lb a year of capacity, returning the nameplate total to about 3.4 billion lb per year.

If cyclohexane reaches forecast production in 1983, nameplate (but not necessarily operating) capacity will run at an average rate of only 50%. However, since at least 400 million lb of capacity is shut down, operating capacity is going at a rate of at least 57%.

This rate suggests that still more capacity might be ripe for shutdown, industry analysts say. Actual scrappage, however, is thought to be a long time off. These plants apparently suffer relatively little from being shut, much like other plants that process hydrocarbons without using corrosive inorganics such as chlorine. Hence, plants on standby will continue to lead to a low average plant operating rate for some years ahead.

On the market side, cyclohexane's price depends directly on the price of raw-material benzene, with a few cents extra thrown in for process and hydrogen costs. Cyclohexane and benzene prices tend to move in tandem, which at the moment means very slowly up.

However, the hydrogen cost factor is becoming much more important for the next few years, if not for a decade or more. Hydrogen has grown more valuable to oil refiners as they move more heavily into hydrodesulfurizing their higher sulfur-content crude oils. As a result, by-product refinery hydrogen, once generally burned as cheap fuel, now has much more highly rated things to do. As yet, the cyclohexane price doesn't reflect the full rise in hydrogen values.

Given the paltry profitability afforded by cyclohexane's current price and the product's huge excess capacity, new investment is unlikely except in special situations. Du Pont's new plant is such a case, built because of the company's large internal needs for cyclohexane and the presence of a large by-product hydrogen supply from nearby chlorine units. So despite this particular project, cyclohexane remains in poor financial shape and can't do much better for a long time.